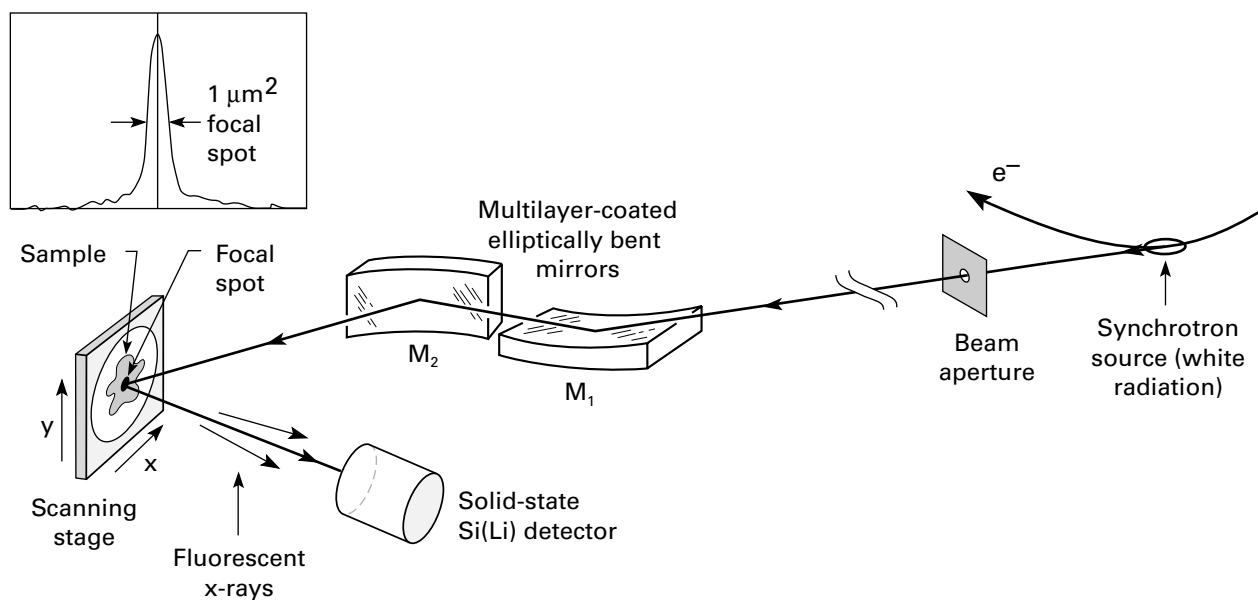


Scanning X-Ray Fluorescence Microprobe • Beamline 10.3.1

Berkeley Lab • University of California

Beamline Specifications

Photon Energy Range (keV)	Photon Flux (photons/s)	Spectral Resolution (E/ΔE)	Spatial Resolution (μm)	Samples	Availability
6–15 (with multilayer mirrors)	3×10^{10} (at 12.5 keV, with multilayer mirrors)	25 (at 12.5 keV, determined by number of periods in multilayer mirrors)	1.0 × 1.2	Flat Solids (<2 cm diameter in air)	NOW
3–20 (without multilayer mirrors)					



Schematic layout of Beamline 10.3.1.

Beamline 10.3.1 is a PRT-owned bend-magnet beamline dedicated to a scanning x-ray fluorescence microprobe for spatially resolved, high-sensitivity elemental analysis of materials, environmental systems, geological structures, and historical artifacts and documents. Owned by the Berkeley Lab's Center for X-Ray Optics, the x-ray microprobe is the x-ray analogue of the electron microprobe.

Light focused by two bendable elliptical mirrors in the Kirkpatrick-Baez configuration illuminates a

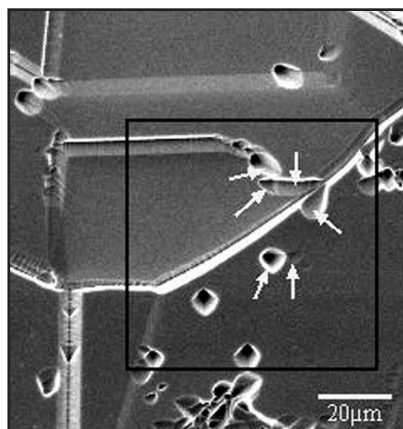
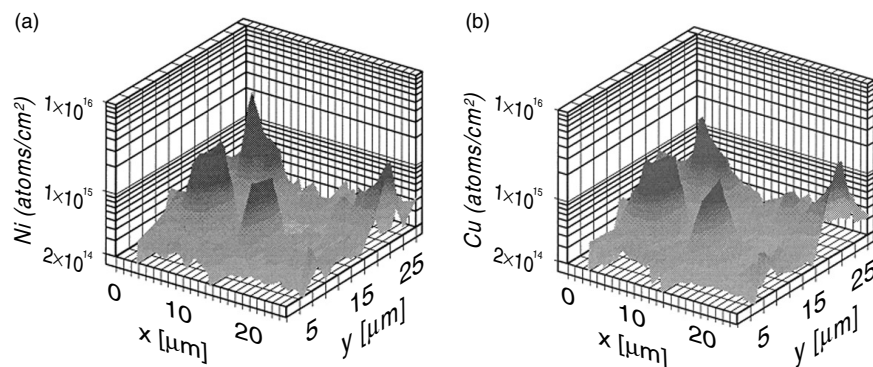
small spot (less than 2-μm diameter) on the sample. The mirrors are coated with multilayer reflectors to increase the reflectivity. A Si(Li) detector records the fluorescence x rays, with the photon energy identifying the element and the intensity its concentration. Scanning the sample through the beam builds up a distribution map for both majority and trace elements.

Sensitivity is in the femtogram range for many elements in the periodic table. A particular advantage of the microprobe is its ability to analyze

materials in ambient environments and without special sample preparation. Fluorescence x rays come from depths of tens of microns, so the microprobe is primarily sensitive to the bulk rather than the surface.

The multilayers have a band pass of about 6%, and the instrument is designed to operate at photon energies over the range from 6 to 15 keV. By arrangement, the focusing mirrors can be removed for white-light experiments from 3 to 20 keV.

The microprobe has served researchers studying such diverse subjects as impurities that lower efficiency in solar cells, grain-boundary segregation of impurities that short-circuit light-emitting diodes, strengthening additives in ceramics, heavy-metal contaminants in wetlands, and a search for toxic elements in hair from deceased persons. White-light experiments include testing x-ray components such as capillary optics, collimators, and detectors. ■



Mapping impurities in solar-cell material. X-ray fluorescence microprobe images of the distribution of nickel (a) and copper (b) in as-grown polycrystalline silicon show that these impurities, which are associated with reduced solar-cell efficiency, occur in discrete agglomerations localized within areas of 2 to 5 μm radius. Comparison of these images with a scanning electron microscope image of etched material shows that the positions of the nickel- and copper-rich areas (white arrows) correlate strongly with dislocations (black pits) but not as much with grain boundaries (lines). Data courtesy of Scott McHugo (ALS).

To obtain a proposal form, go to www-als.lbl.gov/als/quickguide/independinvest.html.

For Beamline Information

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